

Claims

1. A coating composition comprising

a1) a physically drying film forming binder resin or resins;

5 a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

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b) a polymer or copolymer levelling agent of formula (I) $In-[(M)_x-(E)_y]_n$ (I) obtained by nitroxyl mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

15 M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C_1-C_{22})alkyl esters, acrylic acid (C_1-C_{22})hydroxyalkyl esters, methacrylic acid (C_1-C_{22})alkyl esters, methacrylic acid (C_1-C_{22})hydroxyalkyl esters, acrylic acid (C_1-C_{22})alkyl esters or methacrylic acid (C_1-C_{22})alkyl esters which are substituted by amino, (C_1-C_{22})alkylamino, (C_1-C_{22})dialkylamino, $-SO_3H$, epoxy, fluoro, perfluoro or siloxane groups,

20 styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C_1-C_{22})alkyl acrylamide, N,N-di(C_1-C_{22})alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

provided that the amount of unsubstituted acrylic acid (C_1-C_{22})alkyl esters or/and methacrylic acid (C_1-C_{22})alkyl esters is more than 30 % by weight based on the weight of the total

25 monomer mixture;

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

30 y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence ($M)_x$;

n is a number from 1 to 20; and

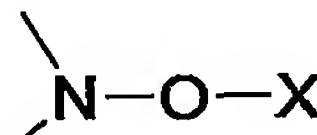
c) optionally water or/and one or more organic solvents.

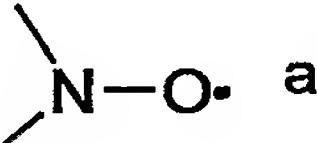
2. A coating composition according to claim 1 comprising
a2) a thermally cross linking film forming binder resin or binder resins; or
a3) a radiation curable film forming binder resin or binder resins.

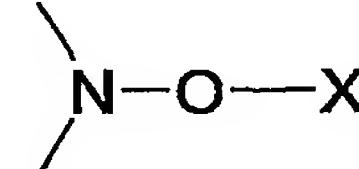
5 3. A coating composition according to claim 1 comprising
a2) a thermally cross linking film forming binder resin or binder resins.

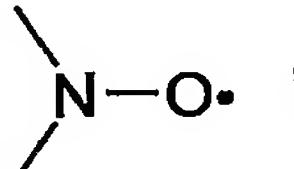
4. A coating composition according to claim 1 comprising
a2) a thermally cross linking film forming binder resin or binder resins without water and
10 organic solvent, which is in the form of a solid powder.

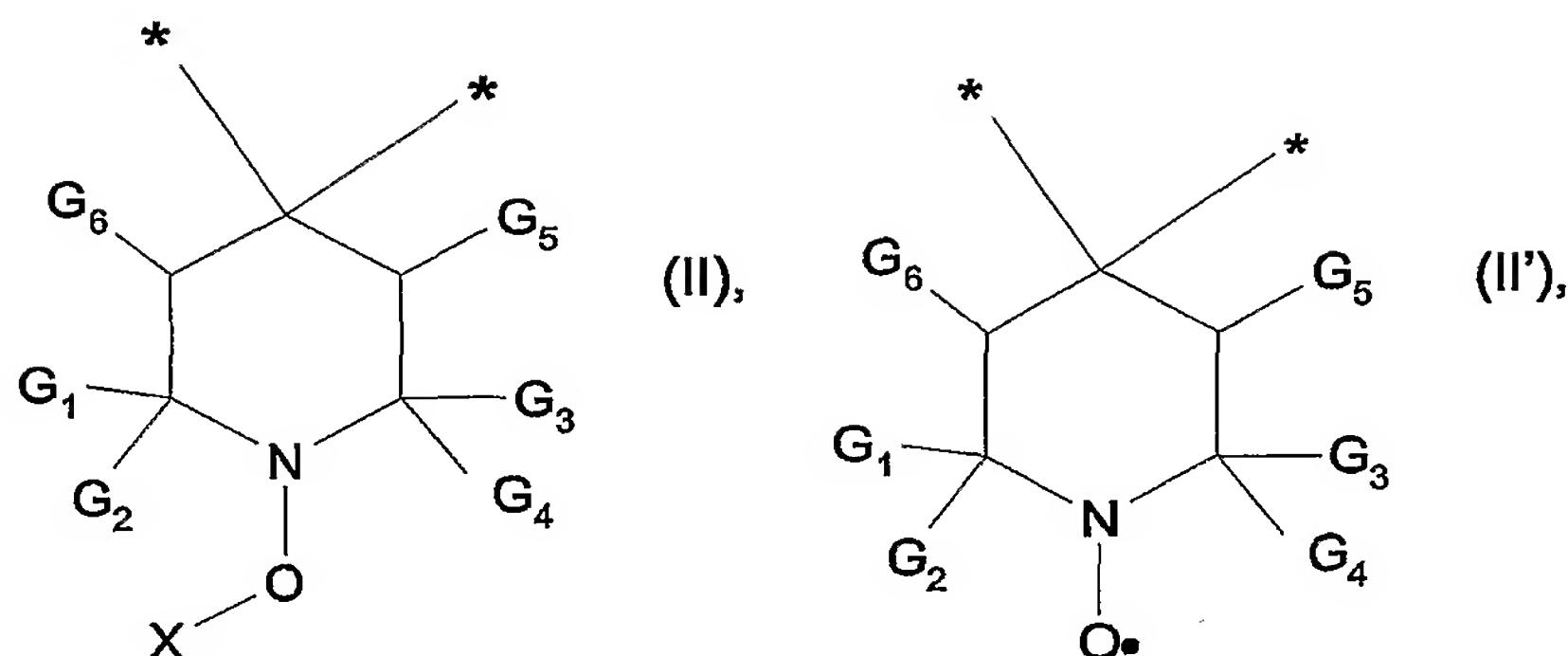
5. A coating composition according to claim 1 wherein the polymer or copolymer levelling
agent of formula (I), is obtained by
b1) polymerization in the presence of an alkoxyamine initiator/regulator having the structural

15 element  ; or by

b2) polymerization in the presence of a stable nitroxyl free radical having the structural
element  and a radical initiator.

6. A coating composition according to claim 5 wherein the structural element 

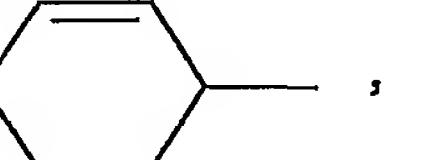
20 is a structural element of formula (II) and the structural element  is a structural
element of formula (II')



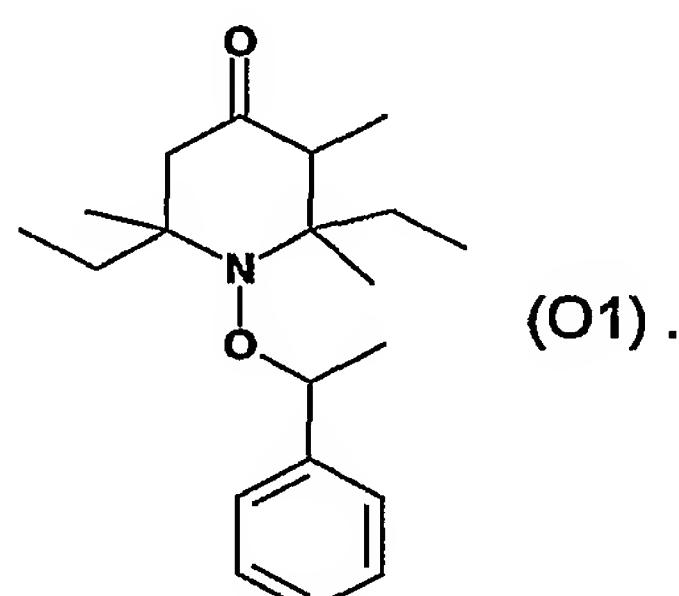
wherein

G₁, G₂, G₃, G₄ are independently C₁-C₆alkyl or G₁ and G₂ or G₃ and G₄, or G₁ and G₂ and G₃ and G₄ together form a C₅-C₁₂cycloalkyl group;

5 G_5, G_6 independently are H, C_1-C_{18} alkyl, phenyl, naphthyl or a group $COOC_1-C_{18}$ alkyl;
 X is selected from the group consisting of
 $-CH_2$ -phenyl, CH_3CH -phenyl, $(CH_3)_2C$ -phenyl, $(C_5-C_6$ cycloalkyl) $_2CCN$, $(CH_3)_2CCN$,

 ,  , $-CH_2CH=CH_2$, $CH_3CH-CH=CH_2$ $(C_1-C_4$ alkyl) $CR_{20}-C(O)-$ phenyl, (C_1-C_4) alkyl- $CR_{20}-C(O)-(C_1-C_4)$ alkoxy, (C_1-C_4) alkyl- $CR_{20}-C(O)-(C_1-C_4)$ alkyl, (C_1-C_4) alkyl- $CR_{20}-C(O)-N-di(C_1-C_4)$ alkyl, (C_1-C_4) alkyl- $CR_{20}-C(O)-NH(C_1-C_4)$ alkyl, (C_1-C_4) alkyl- $CR_{20}-C(O)-NH_2$, wherein
 R_{20} is hydrogen or (C_1-C_4) alkyl and
 * denotes a valence

15 7. A coating composition according to claim 6 wherein the structural element of formula (II) is
a compound of formula (O1)



8. A coating composition according to claim 1 wherein the levelling agent, component b), has a polydispersity of between 1.0 and 2.0.

9. A coating composition according to claim 1 wherein the levelling agent, component b), has a glass transition temperature between 20° C and 200° C.

5 10. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, based on the weight of total monomers.

10 11. A coating composition according to claim 1 wherein the levelling agent, component b), is a linear polymer or copolymer, i.e. in formula (I) n is 1.

12. A coating composition according to claim 1 wherein in formula (I), component b), y is 1.

13. A coating composition according to claim 1 wherein the levelling agent, component b),
15 has a molecular weight of between 3000 to 50000 g/mol (Dalton).

14. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, and 0.5 to 50 % of a functional monomer which is selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C₁-C₆)hydroxyalkyl esters, methacrylic acid (C₁-C₆)hydroxyalkyl esters, acrylic acid (C₁-C₆)alkyl esters and methacrylic acid (C₁-C₆)alkyl esters which are substituted by amino, (C₁-C₆)alkylamino, (C₁-C₆)dialkylamino, epoxy, fluoro, perfluoro or siloxane groups.

25 15. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 50 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate and is a solid at room temperature.

30 16. A coating composition according to claim 1 wherein the levelling agent, component b), is present in an amount of 0.1 to 15% by weight, based on the weight of the film forming binder resin or resins, component a).

17. A process for improving the levelling of a coating composition according to claim 1, which process comprises the steps

applying the coating composition to a substrate and exposing it to thermal energy or electromagnetic radiation in order to obtain a homogenous solid coating.

18. Use of a polymer or copolymer of formula (I), $In-[(M)_x - (E)_y]_n$ (I) obtained by nitroxyl
5 mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C_1 - C_{22})alkyl esters, acrylic acid (C_1 - C_{22})hydroxyalkyl esters, methacrylic acid (C_1 - C_{22})alkyl esters, methacrylic acid (C_1 - C_{22})hydroxyalkyl esters, acrylic acid (C_1 - C_{22})alkyl esters or methacrylic acid (C_1 - C_{22})alkyl esters which are substituted by amino, (C_1 - C_{22})alkylamino, (C_1 - C_{22})dialkylamino, $-SO_3H$, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C_1 - C_{22})alkyl acrylamide, N,N-di(C_1 - C_{22})alkyl acrylamide, and a multifunctional monomer with two or more

15 ethylenically unsaturated bonds;

provided that the amount of unsubstituted acrylic acid (C_1 - C_{22})alkyl esters or/and methacrylic acid (C_1 - C_{22})alkyl esters is more than 30 % by weight based on the weight of the total monomer mixture;

E is a group bearing at least one stable free nitroxyl radical, which is bound via the

20 oxygen atom to the polymer or copolymer; or a group, which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence ($M)_x$;

25 n is a number from 1 to 20;

as a levelling agent for a coating composition comprising

a1) a physically drying film forming binder resin or resins;

a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

30 a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4).

19. A coating composition comprising

a1) a physically drying film forming binder resin or resins;

a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

5 a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

b) a polymer or copolymer levelling agent of formula (X), prepared by atom transfer radical

10 polymerisation $\text{In-}[(\text{M})_x-(\text{E})_y]_n \ (\text{X})$

wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid ($\text{C}_1\text{-C}_{22}$)alkyl esters, acrylic acid ($\text{C}_1\text{-C}_{22}$)hydroxyalkyl esters, methacrylic

15 acid ($\text{C}_1\text{-C}_{22}$)alkyl esters, methacrylic acid ($\text{C}_1\text{-C}_{22}$)hydroxyalkyl esters, acrylic acid ($\text{C}_1\text{-C}_{22}$)alkyl esters or methacrylic acid ($\text{C}_1\text{-C}_{22}$)alkyl esters which are substituted by amino, ($\text{C}_1\text{-C}_{22}$)alkylamino, ($\text{C}_1\text{-C}_{22}$)dialkylamino, $-\text{SO}_3\text{H}$, epoxy, fluoro, perfluoro or siloxane groups,

styrene, substituted styrene, acrylamide and methacrylamide, N-mono($\text{C}_1\text{-C}_{22}$)alkyl acrylamide, N,N-di($\text{C}_1\text{-C}_{22}$)alkyl acrylamide, and a multifunctional monomer with two or more

20 ethylenically unsaturated bonds;

with the proviso that the amount of tert.-butylacrylate is more than 30 % by weight, based on the weight of the total monomer mixture;

E is Cl, Br or a group introduced by nucleophilic substitution of Cl or Br;

x is the total number of monomer units, which is a number between 5 and 5000;

25 y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence ($\text{M})_x$;

n is a number from 1 to 20; and

c) optionally water or/and one or more organic solvents.

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20. Use of poly-tert.-butyl acrylate or poly-tert.butylmethacrylate as a levelling agent in powder coating compositions.